Sandia acquired the Beamlet laser from LLNL upon its decommissioning in FY1998. This kilojoule-class Nd:Glass laser system (with a 1 ω laser wavelength of 1053 nm) was originally developed as a prototype segment of LLNL's National Ignition Facility. In typical designs of high-energy lasers, a master oscillator laser pulse feeds a sequence of successively larger amplifiers. By comparison, Beamlet pioneered a new technology known as the Plasma Electrode Pockels Cell (PEPC) that supported large-aperture (> 30 cm) Pockels cells. Such cells permit whole beam switching from a multi-pass amplifier design in which the equivalent of one beam of NOVA is folded into a much smaller footprint.

The Sandia facility, now referred to as the Z-Beamlet laser (ZBL), was extensively modified to satisfy the backlighter requirements. Z-Beamlet has implemented the following features:

- An on-target wavelength of 526.5 nm (2 ω);
- Pulse durations under typical operation in the 0.2 to 0.5 ns range, with the possibility of placing up to four such pulses over an interval of 20 ns (a configuration known as the picket fence);
- Single pulses that can be generated from 0.2 to 20 ns in duration;
- Total beam energy exceeding 2 kJ for the 20 ns picket fence configuration;
- A single picket (500 J in 0.25 ns) peak power of 2 TW;
- A beam quality capable of delivering over 80% of the 2 ω laser beam in a 50 μm spot size with 150 μm pointing accuracy;
- A backlighter target irradiance exceeding 3 x 10^{16} W/cm^2;
- A shot-to-shot stability (or energy reproducibility) of within 30%; and
- A residual 1 ω at the target not exceeding 1% of the 2 ω irradiance.

The stages and subsystems involved in the laser system are as follows:

- *The master oscillator*: This provides the seed pulse amplified in the rest of the system and establishes the temporal aspects of the output laser pulse. It provides a nanojoule-scale seed pulse at a 250 Hz repetition rate.
- *The regenerative amplifier*: This ring amplifier provides more than 1 million times gain, amplifying the seed to millijoule-scale energies at 0.2 Hz rate. Its roundtrip time of 28 ns limits the picket-fence/single-pulse window to 20 ns.
- *The slicer beamshaping section*: The slicer eliminates pre-and post-pulses out of the regenerative amplifier, while the beamshaper transforms the round Gaussian profiled beam to a square flat-top one.
- *The four-pass rod amplifier*: This second amplifier can boost energies to several Joules of energy every 15 minutes, although typical operations are at the 100 mJ level. Gains are typically around 1500 times net for the four passes.
- *The main cavity slab amplifiers*: Using 11 amplifier slabs in a four-pass configuration, the main cavity can amplify to 6 kilojoules of energy every 4 hours. The cavity switching is by means of the large-aperture PEPC and a polarizer.

- *The transport spatial filter section*: This section includes a single inactive booster amplifier, a transport spatial filter, and the periscope up to the mezzanine level of ZBL. Once the beam is on the mezzanine, a final turning mirror directs the beam towards the Z-Accelerator.
- *The frequency doubling crystal*: A single 37 cm x 37 cm x 1.1 cm KDP crystal takes two photons at 1 ω and converts them to a single photon at 2 ω with up to 80% efficiency.
- *The calibration chamber*: Before the beam enters the Z-Accelerator, this area, located after the doubling crystal, permits optional testing.. With a full x-ray diagnostics suite, this chamber allows experiments to be mocked-up and verifies the backlighting characteristics.
- *The Z-accelerator transport section/ final optics assembly*: This section uses a vacuum relay section to transport the beam over 70 m to the Z-Accelerator. Once there, a final optics assembly (FOA) deflects the beam down towards the z-pinch and focuses it onto a foil there. Two FOAs exist: an on-axis FOA (which sits above the pinch itself and focuses through a 3.2 m focal length lens to a target located 7 inches from axis center) and an off-axis FOA (which sits towards the edge of the center section and folds the beam down at a steep angle before focusing through a 2.0 m focal length lens to a target about 1 mr from axis center).

In addition, an adaptive optics system has key elements located just before and just after the main amplifiers/transport section. This subsystem uses a deformable mirror (just before the main cavity) to change the wavefront and a Hartmann wavefront sensor (just after the folding mirror to the Z-Accelerator) to detect the wavefront. An adaptive optics control system (AOCS) closes the feedback loop and allows wavefront aberrations to be corrected and better focal spot quality to be achieved. The adaptive optics system helps to attain x-ray focal intensities in the 4 to 12 keV range that are then used in the backlighting process.